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NOTES ON THE BIOLOGY OF THE FLORIDA RED SCALE (*Chrysomphalus aonidum* (L.))

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The Florida red scale was first noticed in Florida in 1879 on a sour-orange tree imported from Cuba and planted near Orlando.[2] Although it has been present in citrus groves here for 60 years and has been one of the most destructive scales, second only to the purple scale *(Lepidosaphes beckii* (Newm.)) in damage to trees and fruits, very little has been published on the species. Work on its biology and on control was resumed as a definite work project at the Orlando laboratory in 1936 and is being continued in the new laboratory at St. Lucie.

LIFE HISTORY

METHODS OF STUDY: For the study of the life history of the Florida red scale, in 1939 orange and grapefruit trees that had very few scales on them were selected and tagged for identification. Artificial infestations were obtained by gathering leaves from trees that had heavy infestations and attaching them to the leaves or fruits of the selected trees. The infested leaves were clipped to both the upper and lower surfaces of leaves to be infested, and were fastened to fruits by means of rubber bands. The infested leaves were usually left on for two days so that the crawlers could crawl from under the scale coverings of the females and onto the clean leaf or fruit. After the old leaves were removed, the crawlers that had settled were identified by India ink numbers placed on the leaf or fruit. Each individual that settled was examined every two days when possible, and its stage was recorded. New infestations were

[1]For much valuable advice and supervision the writer is greatly indebted to Herbert Spencer and Max R. Osburn.

[2]Comstock, John Henry. 1916. Reports on scale insects. N. Y. (Cornell) Agr. Expt. Sta. Bul. 372: 276-603, illus.

made the first of each month to determine the influence of the seasons on the time spent in each stage.

The studies were made under as nearly natural conditions as possible. The trees selected were part of a grove and were not artificially protected in any way. The crawlers and marked scales from the artificial infestations were therefore exposed to the weather, predacious insects, and fungi as are the scale insects in any grove. The only difference between the artificial infestations and the natural infestations was the placing of the crawlers on the leaves or fruits and the marking. Supplementary work on some crawlers on potted plants was done in the screened insectary.

NATURAL MORTALITY: From March through September, 820 scales were under observation. Of that number 256, or only 31 percent, reached the second larval stage and only 143, or 17.5 percent, reached the adult stage. Of these adults, 51 were females and 92 were males. Only 10 of the females were able to survive long enough to produce young.

Weather and insect enemies destroyed many of the scales marked for observation. A tropical storm on August 11, with 60-mile gusts of wind and 2 inches of rain in 24 hours, killed 90 percent of a lot of 178 that had settled and had been marked the week before. One trashbug (a hermerobiid or chrysopid) was seen destroying young scales, and the torn coverings of others were apparently the work of predacious enemies. Internal parasites also destroyed some, as indicated by the holes left in the scale coverings. Less than 1 percent of the scales studied showed any evidence of entomogenous fungi.

THE FIRST-STAGE LARVAE: Observations were made during July and August to determine the time between hatching and settling of the crawlers, the time required to reach the white-cap stage, and how long they remained in this stage. The white-cap stage is considered to cover the period from the time the young scale becomes completely covered with the white, waxy substance secreted from the body until the outline of the true scale can be distinguished.

For this experiment two small seedling orange trees were planted in boxes and placed in the screened insectary. Two methods were used for infesting the leaves with crawlers. By the first method the scales of the ovipositing females were lifted and the leaf to which they were attached was held over the leaf to be infested and gently tapped to dislodge the crawlers and

allow them to fall on the clean leaf. By the second method the scale coverings were lifted in the same way and the crawlers were transferred with a fine camel's-hair brush. All the crawlers on the new leaf that did not move were then removed, and the others were watched constantly until they settled. As they settled they were numbered with India ink, and then were examined every few minutes until the first-ring stage was reached, that is, until the waxy covering began to expand laterally, forming a ring around the central nipple.

After the crawlers were placed, they generally went over both the upper and lower surfaces of the leaves, and selected a small area over which they moved carefully until they found the exact place, usually a small depression. When they were settled they began "rounding" almost immediately. The first noticeable change was the disappearance of the antennae and legs. They were apparently drawn under the body, and then a white, waxy substance was thrown up over the body.

Eighteen crawlers were studied. The average time after the crawler was placed on the leaf before it settled was 1 hour and 43 minutes, and 1 hour and 28 minutes for the settled crawler to reach the white-cap stage. The average time spent in this stage was 20 hours and 45 minutes.

The longest period spent in the first larval stage was during March. The average was 19 days, with a range of 17 to 22 days. In June the average was only 10 days, with a range of 7 to 16 days. The average for the 7-month period was 14 days.

With a view of determining how far crawlers would travel with no hindrance, records were made of the distance traveled on smooth paper for 2-hour periods. The crawlers were placed on the paper, and their movements were traced and measured with a map measurer. Six crawlers were observed, and the average distance traveled was 38 inches, with a range of 19 to 59 inches. The average temperature was 86.5° F. and the relative humidity 67 percent.

Observations were also made of five crawlers on mature grapefruit until they settled, and their movements were traced and measured. The average distance was 4 inches, with a range of 1.5 to 9 inches. The average temperature was 77° F. and the relative humidity 84 percent.

To determine what percentage of the crawlers settled under natural conditions, 77 crawlers were placed on orange leaves and were left for several hours. Only 39 were able to settle.

This points to a 50-percent mortality during favorable weather. In stormy weather this would undoubtedly be greater.

THE SECOND-STAGE LARVAE: The time spent in the second larval stage has been determined separately for males and females, because of difference in lengths of time for development. In this stage the males can be distinguished from the females by the color and shape of the outer covering. The male is darker, slightly longer than wide, and more convex than the female; the female has a reddish brown color which gradually turns darker with age, and is flatter than the male. The longest time spent in this stage was in March, when 14 days were required by the male and 23 days by the female. The shortest time spent by the male in this stage was in August, when only 4 days were required. For the female the shortest time was in June, when only 10 days were required. The average for the entire period was 8 days for the male and 15 days for the female.

LIFE CYCLE: The length of time from crawler to oviposition ranged from 52 days when settling occurred in August to 95 days when it occurred in February, with an average of 74 days for all ovipositing females.

A generation, from crawler to crawler, required less than 60 days during the summer.

The span of life for the ovipositing females from crawler to death ranged from 56 days in August to 110 days in January, with an average of 84 days.

THE ADULT FEMALE: When a female scale reached the adult stage, all other scales were removed from the leaf and it was watched closely for the first young. As the young appeared, they were removed so that they would not be counted twice. The most complete record of the number of young that a female produced is from a female that settled June 10. The first young were noticed 59 days after infestation, and the female produced an estimated 102 crawlers in 41 days, of which 51 were able to settle and start development. The full span of life for this scale was 100 days. The average time spent in the adult stage by the females that oviposited was 58 days, with a range of 28 to 80 days.

SEASONAL HISTORY

Work on the seasonal history of this scale was carried on during 1937 and 1938. Leaves were gathered at regular intervals and the scales were examined under binocular microscopes. A percentage method of recording the stages found was used for

this work. The numbers of scales examined each time were counted and classified as eggs, crawling young, males, and females, and were further subdivided as to age where it was possible. The results show that active crawlers can be found in any month of the year and that reproduction of the species is continuous. Reproduction has two peaks each year, the first during March, April, and May, and the second during July, August, and September. The latter peak is responsible for the young that heavily infest the fruit. Weather conditions are thought to be more favorable for reproduction during these months.

SUMMARY

The life span of the female has been found to be about 100 days during the summer months, young being produced within 52 days. The natural mortality of the scale is very heavy, only about 17.5 percent reaching maturity during summer. The most rapid period of growth was found to be in June and the slowest observed was in March. Crawlers may be found in any month of the year, with two distinct reproductive peaks.

BOUNCING BUDS

All entomologists are acquainted with the Mexican jumping beans, but the writer never seems to remember of having heard of jumping buds. Late in February, 1940, Doctor W. A. Murrill was making a comparative study of the buds of plum trees. In the course of this investigation he pulled the buds off of the branches of two Chickasaw plums and placed them in separate piles. To his surprise they did not stay separated, but began to jump about, some covering as much as an inch or two in one jump. This was disconcerting to the eminent botanist who wanted to keep the buds separate. He investigated the cause of this untoward behavior and found that the buds were inhabited by the larvae of weevils. He turned them over to the writer who in company with Doctor Murrill visited the plum thicket and collected more of these plum buds. A considerable percentage of the buds were found to be infested. They dropped from the trees without opening and the larvae pupated in the ground. Some that were brought to the laboratory and placed on moist earth on March 4th emerged on March 23rd and 27th. They were identified by Mr. L. S. Buchanan of the National Museum as *Anthonomopsis mixus* Lec. They were highly parasitized by a Calcidoid identified by A. B. Hahan, also of the National Museum, as a species of *Zotropis*. No opportunity was given to obtain another generation since by the time these weevils emerged the plum blossoms were gone. There can be but one generation a year in plum buds.

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THE SMALL FIRE ANT *Wasmannia* IN CITRUS GROVES—A PRELIMINARY REPORT

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During 1935 and 1936 reports began to come in of annoyance to citrus fruit pickers by small stinging ants. These complaints have increased in number since then, and late this spring there were at least two instances on the East Coast of Florida where picking crews had literally been driven from their work by these ants.

The species concerned, *Wasmannia auropunctata* (Roger), was described in 1863 in a German publication (*1*)[1]. In 1929 M. R. Smith reported its presence in the United States from specimens sent to him from Miami, Fla. (*3*). Later in the same year, W. M. Wheeler (*4*), in commenting on this report, said that in 1924 he had received specimens from the Fairchild place in Coconut Grove, Miami, with the information that the stings of the species were painful. He stated that *Wasmannia* is a very common ant throughout Central America, northern South America, the West Indies, and warmer portions of Mexico, and that in Puerto Rico it is a pest in coffee plantations and coffee pickers are seriously annoyed by it. By that time it had also become well established in the Kew Gardens in England.

[1]Numbers in italics in parentheses refer to Literature Cited, page 14.

In Puerto Rico the ant *Wasmannia* is called the "albayalde". During 1935 and 1936 the "albayalde" was studied there by M. R. Smith (*6*)[2] in connection with coffee insects. He found these ants feeding on honeydew produced by the hemispherical scale *(Saissetia hemisphaerica* (Targ.)), the green scale *(Coccus viridis* (Green)), the aphids *Toxoptera aurantiae* Boyer, *Sipha flava* (Forbes), and *Pentalonia nigronervosa* Coq., and the mealybugs *Pseudococcus brevipes* (Ckll.), *P. sacchari* (Ckll.) and *P. virgatus* (Ckll.). He quoted a statement by another worker, R. H. Van Zwaluwenberg, that the "albayalde" often kills out or displaces colonies of the ants called "hormiguilla" *(Myrmelachista ramulorum* Whlr.) in coffee groves.

RECORDS FOR FLORIDA

In time that could be spared from other work a survey of Florida has been made and infestations of *Wasmannia* have been found in citrus groves or nurseries in the following places:

Florida East Coast	*Central Florida*	*Florida West Coast*
Homestead	St. Cloud	Naples
Perrine	Orlando	Arcadia
Coconut Grove	Winter Park	
Miami	Apopka	
Miami Beach	Auburndale	
Fort Lauderdale		
Fort Pierce		
Cocoa		
New Smyrna		

It is probable that the ant is present in many other places in the lower two-thirds of Florida, but even with the records we now have, we can say that there are many small infestations well scattered through that part of the State.

DISPERSAL

It is probable that these local spot infestations will enlarge slowly each year unless checked. The rate of spread in one city infestation was about 50 feet in one year, and this was by enlargement of the colony's ground network. Although the queens have wings, no flight has been observed, and in the formicary there is no tendency of the queens to fly, but they crawl about wherever the workers go. In a Miami nursery a thriving colony,

[2]Also unpublished reports on investigations of coffee insects, 1935-36, by M. R. Smith, Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture.

with queens and brood, was found 6 feet above ground level in the V-shaped angles on a coconut palm leaf where the green leaf parts are attached to the leaf stem. There is much danger of artificial spread from palm or citrus nurseries, as the ants nest around the bases of the trunks and even under leaf bases and in crevices and depressions located well above ground, and many of these nursery plants are transplanted in a ball of soil in which the ants may be nesting.

DESCRIPTION

Wasmannia is a small golden-brown ant, one of the smallest we have in Florida. The workers may be distinguished easily from other grove ants by their small size, their distinctive color, and especially by their slow, deliberate rate of movement, in broad trails up trunks and branches to the leaves. According to M. R. Smith,[3] workers of *Wasmannia* may be separated from those of the fire ant *(Solenopsis geminata* (F.)) by the antennal club being 3-jointed instead of 2-jointed, by the presence of two spines on the posterior dorsal part of the thorax, and by the absence of teeth on the clypeus. Usually, after a few encounters, it is not necessary to see if the suspected small ant stings severely. This is, however, another sure means of identification, since no other small grove ant stings as severely as the *Wasmannia.* The queens are large compared with the workers, being one-fourth inch long.

NESTING HABITS

Most ants dig definite nest tunnels into the ground, and these may have one or several entrances. The small fire ant is unusual in its nesting habits, as it has no definite nests. It may live between tree trunk and soil at the surface level or just below; often a few queens, brood, and worker masses take possession of holes and decayed places in the tree trunks several feet above the ground. Another favorite place is under leaf bases of palms or palmettos in natural growth adjacent to the groves. Between the trees flat pieces of wood or stones or partially decayed masses of cover crops may be nesting places, and a heavily infested uncultivated grove soon becomes one huge nest network, with foci of queens and brood every 6 or 8 inches and trails of workers connecting these reproduction centers. The presence of moisture and slight shelter for the queens and

[3]Personal communication.

brood seem to be the only essentials for nesting, and it is seldom that the ants go deeply into the ground for these.

NATURAL FOOD

Honeydew from insects is the most important food of *Wasmannia* in Florida citrus groves. In the spring the usual outbreak of the green citrus aphid *(Aphis spiraecola* Patch) curls the new-growth terminals and provides an abundance of honeydew. The tiny ants may be found in the curled leaves attending the aphids and returning down their trails with distended abdomens. *Aphis gossypii* Glover and *Toxoptera aurantiae* (Boyer) are also visited for food. The citrus whitefly *(Dialeurodes citri* (Ashm.)), the cloudy-winged whitefly *(D. citrifolii* (Morg.)), and the woolly whitefly *(Aleurothrixus howardii* (Quaint.)) also produce honeydew. The honeydew from the first two drips down on leaves below the ones infested, and the ants take up the sweet material there, rather than from the insect bodies. The cottony coverings over the woolly whitefly larvae catch some of the honeydew, and the ants crawl over the groups of larvae to take up the food. As the season advances, aphids become fewer and whiteflies more abundant; then soft scales appear, such as the green scale, the Florida wax scale *(Ceroplastes floridensis* Comst.), and the cottony cushion scale *(Icerya purchasi* Mask.). These furnish food, too. The citrus mealybug *(Pseudococcus citri* (Risso)) is especially abundant at times in grapefruit trees, and it furnishes much honeydew during an outbreak. In Florida there is seldom a time during the year when honeydew-producing insects are completely absent.

In addition to these natural sources of food, the ants have been observed feeding on carcasses of land crabs and small animals, and on dead insects. They also congregate under ripe orange and avocado fruits that have broken open in falling to the ground and eat the sweet juices or oils.

OTHER FOODS

Feeding tests made in groves and in a formicary have demonstrated that the small fire ants will eat dry cane sugar, cane sirups, and other sweet sirups, but they show a special fondness for cooked fat meats, such as crisp bacon or fat beef, and also for vegetable oils, such as olive oil and the cottonseed oil from cans of cheap sardines. Milk may be eaten to some extent, but the ants will leave it for sirups or fats.

Wasmannia is a serious problem in households near outdoor infestations; it contaminates foods, is attracted to dirty and sweaty work clothing, and even infests beds and stings severely when rolled upon or touched. The problem of *Wasmannia* as a household pest is under investigation by the Division of Insects Affecting Man and Animals of the Bureau of Entomology and Plant Quarantine, under the local leadership of W. V. King.

STINGING HABITS

Wasmannia does not sting readily. Individuals may wander about over the uncovered skin for some time and cause no inconvenience. They may be made to sting by pressing them down to a tender spot of skin. In the grove they are all over the leaves, eating honeydew, and when the pickers clip fruits, some of the ants are dislodged and crawl about over the clothes. Sooner or later they get between collar-band and neck, or under the shirt or belt, or even between socks and ankles, and then, when pressed, they sting sharply and severely. A single ant may sting three or four times before it can be dislodged. Each stung place gets red and swells, and finally a spot larger than a silver dollar is affected. It may become whiter than the normal skin, or redder. For some people a few stings give only slight passing discomfort, but for others the sting lasts for three days, aching painfully at first, and later itching intensely by spells. If stings are numerous, say a dozen or two within a short time, the victim gets pale and becomes "shaky" and unnerved, and when a picker reaches this stage he quits work. Premiums have to be paid in wages now to get picking done in some of the groves having fire-ant infestations.

RELATION TO OTHER ANTS AND TO BENEFICIAL INSECTS

Wasmannia is more deliberate and much slower in its movements than other ants infesting citrus groves, and has not been observed chasing them or fighting other species. It probably could not catch them. Ants which often visit the same food plants around the edge of a nest network seldom can be found feeding on the same leaves with the small fire ants. Anywhere within the network of a heavy infestation other ant species are conspicuous by their absence. Whether the other ants are put to death by *Wasmannia,* or are repelled by the odors of that species, or are starved out, is not clear at present. But like the Argentine ant, *Iridomyrmex humilis* Mayr., the *Wasmannia* prevails over other species.

The small fire ants do not prevent ladybeetles, such as the vedalia *(Rodolia cardinalis* (Muls.)), from breeding and preying on host insects; the ants and ladybeetles have been found on the same host several times. But it seems that infestations of the cottony cushion scale thrive unusually well in ant-infested groves in spite of the vedalias. Usually, with no fire ants, vedalias clean up such a scale infestation quickly and completely. *Wasmannia* workers have been observed carrying very young cottony-cushion scales in numbers down their trails toward the ground nests. It is almost certain that they deliberately spread this insect from branch to branch and from tree to tree.

CONTROL EXPERIMENTS

(1) DESTRUCTION OF NESTS.—Some species of ants may be controlled by the introduction into the nest of a fumigant such as carbon disulfide or hydrogen cyanide. This is hardly possible with *Wasmannia*, because of the character of the nest network, which covers the ground and even extends up into the trees. Without doubt, harrowing or shallow cultivation of a grove would limit the suitable nesting spots to undisturbed ground around the trees and would help control the ant and slow up its spread into uninfested areas. However, there are large districts in the State where such cultivation is not practiced. To reduce the number of nesting places above ground, old leaf bases should be removed from palms, and wounds and rotten places in citrus trees should be cleaned out and treated.

(2) BARRIER BANDS.—For temporary protection of the pickers and to cut the ants off from their food in the trees, a barrier which is safe for the trees yet effective against *Wasmannia* would be very useful. In preliminary trials, whitewash containing crude carbolic acid and whitewash with bichloride of mercury were ineffective, as they broke up the ant trails on the tree trunks for only a few hours. A home-made sticky band, composed of rosin two parts and castor oil one part by weight, heated until homogeneous (*5*) was quite effective as long as tree branches did not touch the ground or weeds touch the tree. Citrus trees banded with a 2-inch ring of this mucilage soon had a red ring of ants above the band from up in the tree and another below, trying to get past the band. Eventually the ants above the band dropped off, one by one, and the top of the tree became free of ants. However, before this banding can be recommended it must be tried out on a larger scale and its safety

to the trees demonstrated with all principal varieties and in all types of weather.

(3) PROTECTION OF PICKERS.—To lessen the stinging of pickers and of men who prune the trees, some growers try to do the work on cold days, when the ants are not active. But when the ants become more widely distributed, the few cold days that occur will not be enough to do a fraction of the picking, even of those varieties which ripen during cold weather. Some growers provide pyrethrum fly spray, and cloths sprayed with this and tied around the neck repel some of the ants. Elimination or reduction of the ants would be far better protection than either of these expedients.

(4) POISONED BAITS.—Seventeen different poisoned baits have had preliminary trials and three have been used in large-scale grove experiments on control. Baits with sodium arsenite or tartar emetic as the poison are eaten greedily for several days, but after that the ants go back to their natural food, honeydew. Many of the ants drown in the liquid baits, and the presence of these dead individuals in the liquid probably is one factor that causes the ants to leave the bait. To avoid this, 1 percent of agar by weight was incorporated in two formulas, and this gave a semisolid bait that the ants ate longer; but still, after a time, they went back to their honeydew diet. A bait made up like the Argentine ant sirup (*2*), but containing tartar emetic instead of sodium arsenite, is taken readily by the ants and is promising. It would be favored by growers who are opposed to placing arsenic near their trees. When derris or pyrethrum was used as poison in baits the ants were definitely repelled and plugged up the holes in the bait cans with mud.

In a citrus grove near Fort Pierce bait cans have been hanging on 100 tree trunks for two years, and from time to time fresh Argentine-ant bait has been added. The trees have been sprayed regularly for control of scale insects, whiteflies, and rust mites, and this has restricted somewhat the natural food that has been available. A "high water" during this time, lasting only a day or so, drowned many of the ants between the tree rows. This high water, the spraying for insect control, and the ant bait, working together, have reduced the number of ants greatly, so that there was no great inconvenience to pickers of the last crop. However, a few of the ants can still be found, and eradication cannot be claimed.

A heavily infested and neglected citrus nursery at New Smyrna has also had bait cans of Argentine-ant bait for two years. When first seen, soft scale, whiteflies, and aphids were very abundant, and the ants were thriving. The second year a thorough spraying with oil emulsion reduced the natural food supply and thus forced the ants to take the bait, and they were reduced to about one quarter the number present the previous year.

It is very clear from the work so far that poisoned baits can be fully effective only when the natural food supply is cut off. This might be accomplished by the use of barriers around tree trunks, by baiting during the winter months when natural food is scarce, or by thorough spraying to reduce the number of honeydew producers.

ACKNOWLEDGMENTS

In the course of the survey and experimental work on *Wasmannia*, help has been given by many, and among these special mention must be made of W. V. King, Max R. Osburn, J. A. Fluno, Willis Mathis, Norman G. Platts, John R. Springer, and I. C. Clinton. Identifications of ant species have been made by C. F. W. Muesebeck, Wm. M. Mann, and M. R. Smith. Among experiment station and extension workers, especial interest has been shown by Director Wilmon Newell, J. R. Watson, A. F. Camp, W. L. Thompson, and county agents J. R. Gunn and Thomas L. Cain, Jr.

SUMMARY

The small fire ant *(Wasmannia auropunctata* (Roger)) has interfered with picking and pruning operations in infested citrus groves by stinging workers severely. A survey has disclosed a number of infestation spots of limited area in the middle and lower East Coast section of Florida, in central Florida, and on the lower West Coast of the State. Normally, the ants feed on honeydew from scale insects, whiteflies, mealybugs, and aphids, which attack citrus trees, and also eat dead animals and insects, and juices from fallen fruits. They nest on the ground under slight protection, and in trees; heavily infested groves contain a vast network of scattered breeding foci with interconnecting trails which extend up tree trunks and branches to the leaves, where the honeydew is obtained.

Preliminary work on control indicates the advisability of reducing natural food supplies by thorough spraying for control

of honeydew producers. Banding of tree trunks may bar the ants from access to trees and lessen the number of stings for fruit pickers. The use of a can of Argentine ant bait on each tree trunk has reduced the numbers of ants in groves to levels at which pickers are not seriously inconvenienced, but, even with two years of baiting, complete eradication has not yet been attained.

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NOTES ON THE BIOLOGY OF THE FIRE ANT *Solenopsis geminata* (F.) IN FLORIDA AND GEORGIA

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The fire ants comprise a large group of ants belonging to the genus *Solenopsis*, many of which are of considerable economic importance (Stoddard, 1931, 1932-39; Clark, 1931; Gorsuch, 1934; Smith, 1936; Mallis, 1938; Travis, 1938, 1938a; Emlen, 1938; Eagleson, 1940). In this report are included observations on *Solenopsis geminata* (F.) that were made during 1935 to 1939 in the shooting preserve sections of northern Florida and southern Georgia.

NEST.—The mound of this ant is an irregularly shaped, high pile of earth formed as a dump heap of soil carried from the underground tunnels. Some of the larger heaps may contain as much as 2 pecks of soil, and are invariably constructed around some clump of vegetation. In the areas studied these heaps are typically associated with broom-sedge, *Andropogon virginicus* L. The exit tunnels of the mounds seem to have no characteristic locations, and during periods of drought they are loosely plugged with soil particles and bits of plant debris.

The mound itself is a maze of flattened chambers and tunnels, some of which extend laterally from 6 inches to over 100 feet. These are seldom found below 3 inches under the surface of the ground. Flat storage and refuse chambers are frequently built in these passageways. When a lateral channel extends into a clump of broom-sedge, a small network of galleries is formed that appears to be a secondary colony location. The vertical tunnels, which are found as deep as 6 feet in clay and deeper in sandy soils, usually have short and enlarged lateral branches.

There seems to be little soil preference, for nests occur in sterile sand or in heavy clay soils. Colonies may also be found on dry ridges or in swampy areas. Ordinarily, however, there are fewer nests in the heavily shaded areas than in the more open situations.

[1]The identifications of insects in this report were made in the Division of Insect Identification of the Bureau of Entomology and Plant Quarantine; the ants by M. R. Smith, the Coleoptera by E. A. Chapin, the Orthoptera by A. B. Gurney, the mites by H. E. Ewing, and the mealybugs by H. Morrison.

FOOD HABITS.—The food materials of the fire ant are largely grass seeds, which are stored in abundance in the flat lateral galleries in and around the mound. This hoarding habit makes it difficult, where this ant is common, to obtain uniform stands of grasses and other plants having small seeds. Small vegetable seeds are removed systematically from rows in the garden if planted near the nests. The ants so injure the bark and cambium of citrus and other plants that the sap oozes out, and in extreme cases the plants are girdled and die.

This ant will also come into kitchens and pantries to feed upon foodstuffs. It is especially attracted to meat and milk products, sweets, and cereals.

The fire ant viciously attacks other insects and, especially in the early fall, feeds extensively on cutworms and grasshoppers. The dump heaps around the nests show fragments of many species of insects and millipedes. This ant will eat any animal which has recently died, but meats in advanced stages of decomposition are not especially attractive. Fire ants have been observed stroking aphids and feeding on the honeydew as it is excreted, and also lapping up honeydew that has fallen on the foliage of plants. They have not been seen, however, transporting the aphids.

Plant exudates and other very moist materials are covered with soil particles and plant debris, thus furnishing an earthen canopy under which the ants feed. It appeared from field and cage observations that little or no solids are eaten. In feeding on seeds, the ants appear to extract only the oils and juices from the germ, discarding the other parts. The seeds are frequently found in a rather wet condition in the mound, tightly packed in storage chambers.

The chief injury to quail occurs at hatching time, when the ants enter the pipped egg and destroy the chick before it can leave the shell. Nothing remains but the harder portions of the skeleton. In the field it appeared that the ants often entered the eggs before they were pipped. However, three normal quail eggs, placed in a fire ant nest, were uninjured after 3 weeks in the mound. Stoddard (personal communication) has seen cases where it appeared that the ants had penetrated unpipped eggs, and possibly they may have done so, for some quail eggs are very soft. Damage to the nest may result in either partial or total destruction of the eggs and young. The former is of more importance in decreasing the quail crop because if even one

chick escapes, the quail will not renest, whereas if the entire clutch of eggs is destroyed, or if the ants force the brooding quail to desert the nest, renesting will occur. The only observation made of ants infesting nests of other birds was in the case of a brown thrasher's nest which was situated 6 feet from a large fire ant colony. The ants were seen climbing about over the nestlings, but there was no apparent damage to them.

During the years 1924 to 1937 inclusive Stoddard (1931, 1932-39) and his coworkers had a total of 2,456 quail nests under observation, of which 151, or 6 percent, were destroyed, either all or in part, by fire ants. Such losses ranged from 4 to 16 percent annually during the period 1927 to 1937 inclusive. No ant damage was noted during the years 1924 to 1926 inclusive.

The abundance of the fire ant in the shooting preserve sections of Georgia and Florida may be influenced by certain game management practices. It is conceivable that the controlled burning programs which keep the land more open and stimulate the growth of game-food plants may also improve the environment for the fire ant; at least, more food is available to them on the burned than on unburned areas.

MIGRATION.—An accurate study of migration has not been possible because of an intricate underground system of channels through which the ants may move. Usually migration is a combination of external and subterranean movement. When the lines of travel are external, particularly when the soil is more plastic following a rain, the march is through termite-like passageways formed of soil pellets.

The colony may leave the primary nest with no sign of the direction of travel or as to where it has relocated. Some colonies move if only slightly disturbed, whereas others remain in the same location even when the mound is largely destroyed. Many nests have remained in the same location for at least 4 years, whereas others never seemed to have a permanent nest-site.

It appeared that some of the migration may be for sanitary purposes, for all food stores are left behind. Movement of this type was common when poisoned baits were placed in or on the mound.

Perhaps because of the tillage of the soil by the ants, and the accumulation of organic wastes, colony sites can be detected by the more luxuriant vegetative growth around them. In the early spring mounds can be be located by a mat of sprouting grass seeds.

Certain colonies have been observed to show no external sign of activity for as long as 8 months (May to December, 1936). The ants in these nests did no excavating, the mound became flattened by the weather, plants rapidly obscured the location, and the presence of fire ants was determined only by digging into the old mound.

LIFE HISTORY.—Six mother queens, collected in the spring, were immediately placed in formicaries. The number of eggs laid within the first 24-hour period after isolation ranged from 339 to 1,123, with an average of 639. Two dealated queens collected in August laid only 15 and 25 eggs respectively within a 20-day period. Observations on the seasonal abundance of young in the nest also indicated a low period of reproduction from the late summer to the early spring. Although no accurate counts have been made, a normal colony may be composed of several thousand major and minor workers.

Because of the cannibalistic habits of the fire ant in cages, no detailed life-history data have been secured. Eggs kept at air temperatures have hatched in 14 to 30 days, and at 24° C. in 12 and 13 days. A mother queen confined in a cage reared mature workers in 44 days.

The developmental time for queen and male prepupae and pupae was determined from specimens collected from the ant nests and reared in cages. The mean durations and standard errors, in days, of the prepupal and pupal stages for each sex were as follows: Prepupal stage, 59 queens, 5.5 $\pm$ 0.07, and 97 males, 6.1 $\pm$ 0.06; pupal stage, 73 queens, 18.5 $\pm$ 0.08, and 125 males, 19.0 $\pm$ 0.08. "Student's" *t*-test for significance for the mean prepupal and pupal stages shows the differences in developmental periods for each sex to be significant.

A count of 2,632 alate pupae and imagoes indicated a sex ratio of queens to males of 5:6, but rarely were the sexes evenly distributed within a single colony. Sexual larvae were first recognized in the colonies April 19, 1936, April 27,[2] 1937, and April 2, 1938; alate forms were first seen May 7, 1936, May 18, 1937, and May 10, 1938; the first flights were seen June 9, 1936, June 2, 1937, and May 28, 1938. The last immature sexual forms were seen in the colonies (in 1936-38) during the first half of the month of October, when 20 percent of the colonies contained immature individuals. Up to the last of

[2]At Immokalee, Fla., male and queen prepupae were present February 9, 1937.

December alate forms were found in about 25 percent of the colonies, and all were gone by the middle of January.

The flights of the winged forms occurred between 5:00 and 6:30 p. m. on days following rains. No normal flights were noted during periods of drought, but heavy sprinkling of the ground stimulated flights.

While the alate forms were issuing from the nest and until the flight stopped, the workers appeared excited and swarmed about over the mounds. Frequently the queen started her flight with workers clinging to her. The queens usually climbed high on vegetation to start the flight, whereas the males tended to fly more directly from the mound. Flights occurred from the same nest over a period of at least several weeks. The queens and males exhibited no sexual excitement either at the colony or in the cages.

To determine whether the alate queens would lay fertile eggs, a series of 670 winged queens were collected as they flew from the nests and were confined in cages both with and without males. Of these, 503 did not oviposit, and 167 laid from 1 to 273 eggs per queen. Forty of the queens shed their wings before laying eggs, and eight that shed their wings did not oviposit. The first eggs appeared 7 to 15 days after the queens were collected. They were cared for by the queens, but no embryos developed.

No more than one functional queen has ever been located in a colony. However, in each of 12 mounds under observation the number of workers dwindled for about 3 months after the mother queen was removed, and then new broods suddenly appeared in 7, while all activity ceased in 5. The seven nests continued active for over 3 years, and at least for the first 2 years no sexual forms, either alate or dealate, could be located. At the end of 2 years slight activity had been resumed in 4 of the 5 inactive colonies. It is not known whether these were new ants or were some of the original colony.

As a further check on the reproduction of young after the queen had been removed, 13 colonies of workers were collected with an aspirator and moved to new locations without young or a queen. Two of these groups persisted for about 2 months and finally disappeared. The other 11 never established a nest, but dispersed and disappeared.

The observation that colonies continued to reproduce after the mother queen was removed is important in the control of ants. It has been generally assumed that when the queen is

destroyed the colony will not survive. Unless each fire ant colony possesses more than one queen—and there is no proof that they do—the elimination of the queen does not necessarily mean the destruction of the colony.

FIGHTING INSTINCTS.—Unlike many species of ants, fire ants swarm rapidly out of the colony to attack an intruder. Merely the blowing of the breath on the mound, or the stamping of the foot near the mound, calls forth hordes of fighters. Once they are on the intruder they fasten firmly with their sharp mandibles and double up to insert their sting near the point where they are holding with their jaws; both their bite and their sting are painful.

If a colony moves within the territory of another there is a fierce battle. The lion ants, *Dorymyrmex pyramicus* var. *flavus* MacCook and *Dorymyrmex pyramicus* var. *niger* Pergande, continually harass the colonies, particularly if the nest has been weakened. When the lion ants are attacking, the fire ants will be seen clinging to the ground with the posterior end of the abdomen lifted high, pointed at the foe, and waving nervously around. Occasionally a drop of liquid can be seen on the tip of the abdomen. The lion ant strives to grasp his adversary without coming in contact with the posterior end of the fire ant. If the tip of the abdomen is touched—in fact, it appears that the actual contact is not necessary—the attacker will suddenly dash away and rub itself hurriedly on the ground as though attempting to rub off the irritating substance. After a short period of cleaning it is ready to attack again cautiously. Only rarely were fire ants observed to be disabled by the lion ants. The only ant that was observed to subdue the fire ant was *Camponotus abdominalis* subsp. *floridanus* (Buckley). This ant would approach fire ants and rapidly cut them up with its mandibles. If a fire ant succeeded in grasping its large relative it was pulled off and killed.

ENEMIES.—Two small colonies of fire ants were observed to be destroyed by a large colony of the legionary ant, *Eciton (Neivamyrmex) nigrescens* (Cresson). During February and March the migrating sparrows scratch nearly every mound flat in quest of the stored seeds. Cotton rats also feed on these seed supplies during January and February. Stoddard (personal communication) has observed brooding quail feeding on the ants as they came within reach, and from the numbers of these insects in the crops of such birds concluded that the quail might protect the hatching chicks if the ants were not too numerous.

MYRMECOPHILES.—Particularly where the fire ant is common, there are small scarabaeid beetles, *Euparia castanea* Serv., in the ant nests. The ants carefully tend these beetles and in the cages continually clean them at the junction of the elytra and the pronotum. In several colonies the myrmecophilic cricket, *Myrmecophila* sp., was found. The thief ant, *Solenopsis molesta* (Say), builds its tunnels between those of the fire ant. The mealybug *Pseudococcus* sp. occurred frequently on the roots of broom-sedge in the fire ant nests. A tarsonemid mite of the family Disparipedidae was frequently seen riding about on the ants. While on the ants, the mites stand rather erect, bobbing up and down and tapping the ant with the first pair of legs. They have been seen to feed on liquids on the mouthparts of ants and occasionally they feed on the excreta at the anal opening of the ant. The ants frequently attempt to dislodge the mites when they first attack, but usually the ants pay no attention to them. Two staphalinid beetles lived in the ant mounds; one belonging to the subfamily Tachyporinae was present when the colony was occupied, and the other, *Paederus littoreus* Aust., was usually seen only when the colony was deserted.

SUMMARY.—The biology of the fire ant, *Solenopsis geminata* (F.), has been studied in northern Florida and southern Georgia. The mound of this ant is a high, irregularly shaped pile of earth with lateral tunnels that radiate from 6 inches to more than 100 feet from the mound, and with vertical tunnels that extend 6 or more feet deep.

The fire ants are omnivorous in habit, but they feed mainly on small seeds which are stored abundantly in the nests. They seem to take only the juices from their food materials and discard the solid portions.

An accurate study of migration has not been possible because the ants move readily through underground passages. Some colonies never seem to have a permanent nest-site while others have been observed to remain in the same location for at least 4 years. Colonies have been observed to remain inactive for as long as 8 months.

Captive mother queens laid as many as 1,123 eggs in a 24-hour period. The eggs hatched in 14 to 30 days, and workers were reared to the adult stage in 44 days at summer temperatures. Alate queens and males had a prepupal stage, respectively, of 5.5 and 6.1 days, and a pupal stage respectively of 18.5 and 19.0 days. A sex ratio of queens to males was 5:6 for

a sample of 2,632 individuals. Sexual larvae first appeared in the mounds April 2 to 19; alate forms, May 7 to 18; and first flights, May 28 to June 9. The flights occur between 5:00 and 6:30 p. m. on days following rains. Alate forms were present in 25 percent of the colonies up to the last of December. Some winged queens, captured as they flew from the nests, laid eggs, but these were not fertile. Seven of 12 colonies, from which mother queens were removed, continued to produce young for over 3 years.

When disturbed, the fire ants swarm from their colony to attack an intruder. Both their bite and sting are painful.

The legionary ant, *Eciton (Neivamyrmex) nigrescens* (Cresson), has been observed to destroy two fire ant colonies. Cotton rats and migrating sparrows dig into the mound in the spring and rob the seed stores of the fire ant.

The following myrmecophiles were collected from fire ant colonies: a scarabaeid beetle, *Euparia castanea* Serv.; a cricket, *Myrmecophila* sp.; the thief ant, *Solenopsis molesta* (Say); mealybugs, *Pseudococcus* sp.; a tarsonemid mite belonging to the family Disparipedidae; and two staphilinid beetles, *Paederus littoreus* Aust., and a species belonging to the subfamily Tachyporinae.

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ENTOMOLOGICAL PROBLEMS IN THE EVERGLADES

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Everglades Experiment Station

In this discussion of the Entomological problems of the Everglades it may be well to first consider briefly the geology of the area. Most of you are at least casually acquainted with the area around Lake Okeechobee, but probably many of you know of this part of the state only from hearsay.

The Floridian plateau,[1] as described by geologists, has been in existence since very ancient time. It was probably dry land during the Triassic and Jurassic periods and the Lower Cretaceous epoch, but it was covered by the sea during part of the Upper Cretaceous time. During the Cenozoic era its shore underwent many shiftings, but it was never very deep under water nor has it been lifted very high above sea level. Since Florida is far from the Piedmont Plateau, the origin of all sand and gravel, the original sedimentary deposits contained more limestone than sand or clay.

The mica schists, quartzites and other rocks that form the foundation of the Floridian plateau are about 4100 feet below the surface and are only slightly known.

One class of lakes in Florida are those that fill original depressions in the floor of the sea. Lake Okeechobee, 35 miles across, and next to Lake Michigan, the largest body of fresh water wholly within the United States, is the most conspicuous example of this class. The Everglades form a level, grassy plain that slopes gently southward from an altitude of about 18 feet above sea level near Lake Okeechobee, and merges into the mangrove-covered keys in Florida Bay. This plain is underlain with Pliocene shell marl and limestone, which is generally covered by six to eight feet of peaty muck. Before their artificial drainage the Everglades was usually flooded, but now so much of the water is carried off by canals that the higher parts stand above normal water level.

For convenience in this paper I have arbitrarily divided the subject into two parts, problems of management and problems of entomology. All of us are quick to admit that climate, soil, plant diseases, etc., interact and react upon the insect populations. As a result there should be the fullest cooperation be-

[1]Cook, C. Wythe, and Stuart Mossom, Geology of Florida, Twentieth Ann. Rept. Fla. State Geology Survey, pp. 37-43, 1929.

tween the entomologist, soil chemist, horticulturist and plant pathologist. It is readily admitted that with cooperation between the various branches of agricultural research experiments can be designed that would give more reliable information on all the factors involved. This information could be obtained more quickly and cheaply, and would be more accurate than results so far obtained. It is ridiculous for the entomologist to ignore the problems of soil management, plant pathology or horticulture. He could not grow his crops for experimentation. It is then even more ridiculous to publish entomological findings when the same crops could be treated more effectively in a joint publication giving the results of the work of the several men concerned, where the experiments have been designed and carried out in a spirit of true cooperation. The practical farmer is forced to consider soil management, plant pathology, horticulture and entomology all at the same time. It is, therefore, somewhat confusing for him to have to read publications which discuss his problems from only one angle. We sometimes complain that the farmer does not readily put into practice our recommendations. I feel that this lack of cooperation between the various research fields may be largely to blame. What is the farmer to do when he gathers the horticultural, plant pathological, and entomological publications and finds glaring contradictions or recommedations impossible to follow because of conflicts with other necessary farm operations? We are expected to be leaders and if we are to lead we must first learn to cooperate among ourselves.

An example showing the benefits of interdepartmental cooperation can well be personally illustrated as follows: After testing several insecticides for the control of the corn budworm, *Laphygma frugiperda* S. and A., and finding effective sprays too costly for commercial corn production, the agronomist and myself designed an experiment to compare various spray materials with different spacings of corn. The results showed that far more effective control of the budworm was obtained by simply making closer plantings than by the use of any of the insecticides tested. This control was probably due to the same number of insects attacking a greater number of plants with proportionately less damage. This example illustrates the benefits resulting from cooperation and shows the possible effectiveness of experiments designed to cover all phases of a problem.

Other problems of management which the entomologist should consider are those of climate, drainage and irrigation. Time does not permit a full discussion of these subjects. Another important problem of entomological research is the financial problem. I expect that the research man never existed who was completely satisfied with his research conditions. His budget is too limited (which is too frequently the case), his surroundings are not satisfactory, or a number of other minor dissatisfactions may be present. However, the problems of a limited budget are the most common source of irritation. We love to dream of what we would do if our budget were unlimited, but fortunately this is not a dream world. We are forced to do the best we can with what we have and that best can be excellent if we really exert ourselves to the utmost.

Now let us take up the special entomological problems of the Everglades. I have listed first the effect of climate on insect populations and insect research. In the Everglades the bean leaf hopper, *Empoasca fabae* Harr., is present in destructive numbers usually only in the spring, while in the central part of the state it is present only in the fall. I have done some speculation as to why this is true; but to the present time speculation is as far as the problem has progressed.

Our crops are grown from September to June because of the climate. As a result aphids on pepper, tomatoes and English peas are particularly difficult to control. These insects are most abundant during December and January. These are periods when comparatively low temperatures, and high winds prevail. The insecticides we now have are most effective during periods of calm weather when the temperatures are 80° F. or above.

Another problem resulting from climatic effect is the periodic outbreak of such insects as the onion thrips, *Frankliniella tabaci* Lindm., on beans. During the spring of 1937 tobacco thrips became so abundant that it was economically impossible to control this insect.

In the Everglades such large areas are planted to single crops that most growers have turned to the practice of applying insecticides and fungicides by airplane. It is not necessary to discuss these problems as they have already been ably presented to this society by Dr. Ralph Miller in his presidential address in December, 1937.

Other special problems which I shall take time to only mention are the sugarcane borer, wireworms, mole crickets, cut-

worms and army worms. Heretofore, the principal means of control for the sugarcane borer, *Diatraea saccharalis* Fab., has been the introduction of parasites. These are no doubt beneficial but the borer population is steadily increasing. One peculiar phenomena that has not been explained is the fact that the Eastern Division of the U. S. Sugar Corporation has approximately five times the borer infestation of the Western Division. Dusting with cryolite is being investigated and shows much promise. Wireworms, *Melanotus communis* (Gyll.) and *Aiolus dorsalis* Say, are causing increasing damage to both cane and truck crops. It has been shown that these insects can be controlled with several soil fumigants, but these materials are not economically feasible. The only practical solution of the problem appears to be flooding during the peak of adult emergence or clean cultivation. Mole crickets are now causing great losses in the Plant City and other areas. The species present on the Experiment Station land, recently identified as *Grylotalpa hexadactyla*, is increasing in abundance. Cutworms and armyworms of several species occasionally cause severe damage. Their periodic abundance is probably due to climatic factors which have not been studied in the Everglades. The bean leaf roller, *Goniuras proteus* L., is frequently a serious menace to the production of snap beans during the fall.

There are a number of other problems which need attention. Now we have gotten back to the problems of finance and it is time to close. However, I would like to emphasize again the need for more money to work with and above all the need for more cooperation in the future between the various workers.

FLORIDA ENTOMOLOGICAL CONFERENCE

The next Florida Entomological Conference sponsored by the Newell Entomological Society will be held in Gainesville, March 27, 28, 1941. The Conference will feature the Silver Anniversary of the Plant Quarantine Service in the State of Florida as conducted by the State Plant Board. Dr. Lee A. Strong, Chief of the Bureau of Entomology and Plant Quarantine will be honor guest. Quarantine officials from all parts of the United States, Canada, and South America are invited to attend.

Any member of the Florida Entomological Society may obtain the Constitution and By-Laws, adopted at the 1939 annual meeting, by requesting a copy from the Secretary or the Editor of the FLORIDA ENTOMOLOGIST.

PROCEEDINGS OF THE ANNUAL MEETING OF THE FLORIDA ENTOMOLOGICAL SOCIETY

Gainesville, Florida, December 13-14, 1940

This meeting celebrated the 25th anniversary of the founding of the Society, which was organized on January 5, 1916. Of the eleven men present at the first meeting, four, Dr. E. W. Berger, Mr. J. C. Goodwin, Dr. Wilmon Newell, and Prof. J. R. Watson also attended the 1940 meeting.

Dr. Herbert Spencer presided at the meeting and chose as the subject of his presidential address, History of the Florida Entomological Society. Dr. H. T. Fernald gave a paper on the Structure of the Taenidia of Insects. Various phases of the Mole Cricket Campaign in Florida were discussed by Mr. C. B. Wisecup, Mr. G. B. Merrill, and Mr. A. H. Madden. Dr. Homer Hixson gave a paper on Medical and Veterinary Entomology in Florida from a Teacher's Point of View. A paper by Mr. W. L. Thompson, Some Notes on the Control of Scale Insects, was read. Dr. W. V. King and Mr. G. H. Bradley presented a paper on the Distribution of Anopheline Mosquitoes. Professor J. R. Watson spoke on the Migrations and Food of the Lubberly Locust and Dr. J. W. Wilson discussed Entomological Problems in the Everglades. Mr. L. S. Maxwell showed some Kodachrome Slides of Insects and Diseases of Ornamentals and Mr. S. O. Hill illustrated his talk on Pecan Insects and Damage with colored slides. Mr. C. D. Kime spoke of the Objectives and Activities of the Farm Products Department of the Tennessee Coal, Iron and Railroad Company.

The Silver Anniversary Dinner of the Society was held Friday evening, December 13, with Dr. H. Harold Hume, dean of the College of Agriculture acting as toastmaster. This function was held in honor of Professor J. R. Watson, the first president of the Society and editor of the FLORIDA ENTOMOLOGIST since its beginning in 1917. Credit for the success of the dinner is due the Committee on Arrangements, consisting of Dr. Homer Hixson, Dr. H. K. Wallace, Mr. James P. Toffaleti, Mrs. Homer Hixson and Mrs. Daniel B. Fogarty. Music was furnished by Miss Tommy Ruth Blackmon, and members of the Newell Entomological Society presented an original entomological skit. The dinner was enjoyed by about sixty entomologists and guests.

The roll of the Society was appreciably lengthened with the election of several new members. Stephen S. Easter, Mrs. C. N.

Grimshaw, W. S. Fletcher, C. D. Kime, W. W. Lawless, W. R. Lyle, H. C. Moennich, T. W. Reed, and J. C. Stancil were elected to Associate Membership, and the following were elected to Student Membership: Edwin W. Booth, Nathan B. Carson, George Wallace Dekle, Daniel B. Fogarty, James J. Friauf, James S. Haeger, Norman C. Hayslip, Frank A. Lee, Russell C. Peeples, Jr., Richard M. Remington, Clarence M. Robinson, Andrew J. Rogers, Edwin L. Seabrook, Lowell E. Slagle, and T. W. Zeigler. The membership status of R. C. Bushland, Willis Mathis, and J. A. Mulrennan was changed from Associate to Active Membership.

Officers for 1941 are: President, Homer Hixson; Vice-President, K. E. Bragdon; Treasurer-Business Manager, J. W. Wilson; Secretary, A. N. Tissot; Editor of the FLORIDA ENTOMOLOGIST, J. R. Watson; Associate Editor, E. W. Berger.

A. N. TISSOT, Secretary

REPORT OF THE TREASURER-BUSINESS MANAGER OF THE FLORIDA ENTOMOLOGICAL SOCIETY FOR THE FISCAL YEAR ENDED NOVEMBER 30, 1940

Receipts:	
Balance, November 30, 1939	$ 54.62
Dues and Subscriptions	111.00
Advertising	71.00
Sale of back numbers	18.01
Sale of index	2.25
Plates and Reprints	14.99
Collected on old account	36.00
Total Receipts	$307.87
Disbursements:	
Pepper Printing Co., Printing the Florida Entomologist and Supplies	$127.87
Pepper Printing Co., Old Account	51.00
Exchange to Bank	2.60
Postage	23.68
Total Disbursements	$205.15
BALANCE, NOVEMBER 30, 1940	$102.72

Signed: J. W. WILSON

I hereby certify that the books have been examined and the above statement found to be correct.

Signed: H. K. WALLACE
Auditing Committee

CORRECTION: Volume XXIII, No. 1, Pages 5 and 6. *Preliminary Report on Wireworm Investigations in the Everglades.* J. W. WILSON.

On Table 2 and Table 3 the figures given are for 1/20th acre plots instead of one acre as stated in these tables.